

A · G · A · V · E



Quarterly Magazine of the Desert Botanical Garden, Phoenix, Arizona

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ABOUT THIS ISSUE



Dear Friend,

If I had to estimate the value of the Desert Botanical Garden to the City of Phoenix, I'd come up with a figure that went from here to the horizon.

The Desert Botanical Garden is a precious resource to the City of Phoenix, providing services and expertise no price tag can cover. The Garden contributes to an improved way of living in our Sonoran Desert location.

I'm very enthusiastic about the work that the Desert Botanical Garden does to promote landscaping in the desert with natural plant material to conserve our precious water, while creating beautiful and unique settings.

This issue of Agave Magazine brings together two partners with a purpose — the City and the Garden. I hope the special articles inside will create a better understanding of the Sonoran Desert and the many ways to landscape with plants in our environment.

Sincerely,

Terry Goddard
Mayor of Phoenix

CONTENTS

Introduction	Page 3
<i>by Robert G. Breunig, Ph.D., Executive Director</i>	
Native Landscaping	Page 4
<i>by Suzanne Nelson, Staff Horticulturist</i>	
Desert Gardening	Page 7
<i>by Mary Wilkins, Staff Horticulturist</i>	
Planting Tips for Desert Gardeners	Page 10
<i>by Judy L. Mielke, Staff Horticulturist</i>	
How Much Water Is Enough?	Page 11
<i>by Steve Priebe, Chief Horticulturist</i>	
Poolscaping	Page 12
<i>by Judy L. Mielke, Staff Horticulturist</i>	
Xeriscape: Creative Residential Landscapes in a Desert City	Page 14
<i>by Kent C. Newland, Water Resources Specialist, City of Phoenix</i>	

COVER: A Scottsdale resort preserved much of the natural Sonoran Desert in open spaces and used drought tolerant plantings to provide seasonal color and greenery.

This issue of Agave is co-sponsored by the Desert Botanical Garden and the City of Phoenix Water and Wastewater Department, Water Conservation and Resources Division.

INTRODUCTION

by Robert G. Breunig, Ph.D.

Executive Director, Desert Botanical Garden

A Sense of Place ...

The Desert Botanical Garden is pleased to publish this special issue of *Agave* magazine on landscaping in a desert environment.

Landscaping is not usually considered a critical issue in a large urban community. For the cities of the arid Southwest, however, this is not the case. As Kent Newland describes in his article on Xeriscaping, fifty percent of the water consumed by a typical family residence in Phoenix, is used for landscape irrigation. Thus, the use of water conserving desert landscape plants and designs by the citizens of our community can have enormous impact on our total municipal water consumption.

Those of us who live in the Salt River Valley are desert dwellers and we live in a land of limited water resources. Even as we divert waters from the over-committed Colorado River and pump non-renewable fossil water from underground aquifers, there are some who claim that we have no water problems. But this is a short term view. I believe we should take a longer view by recognizing that our desert civilization is still a young one. If our tenure on this level is to be measured in centuries rather than decades then we must take our water limitations seriously by conserving as much of this water as possible for future generations. Nor should we continue to deny that we live in a desert by trying to transform our land into something it can never be through the use of exotic, high-water use plants. Rather, we can celebrate the natural beauty of our desert by encouraging the use of desert plants in dynamic landscape applications. This approach can bring great benefits to our community. Not only will it save significant quantities of water but it will add greatly to our community's character and sense of place. As each visitor or new resident comes to the Valley and experiences the rich variety of shapes, color, texture and sizes



We can celebrate the natural beauty of our desert by using desert plants in dynamic landscape applications. Photo by Bill Woodward.

offered by desert plants, they will come to better appreciate the uniqueness of our Sonoran Desert. As this public appreciation deepens so, too, will interest in desert preservation. We hope that this issue of *Agave* — and all of the

efforts by the Garden, our municipal governments, civic leaders, forward-looking nurserymen and others — will help in the long overdue awakening of our residents to the true landscape potential of desert plants.

More Than Just Cactus and Rocks:

NATIVE LANDSCAPING

by Suzanne Nelson



W

ithin the last few decades, increased awareness of natural resources, ecosystem management and native flora has supported the utilization of native plants in landscape designs throughout the country. The economical considerations of using natives have been widely underscored

over the years, mainly in terms of water savings and overall low maintenance. However, native landscaping has appeal other than economic.

Landscaping with native plants is a method by which the unique individuality of an area is established, as well as its heritage. Because plants are a basic part of what makes up a particular environment, their use in landscape design helps support the qualities characteristic of that environment. "Think

how much more interesting a trip across the country would be if you could see the uniqueness of each environment expressed in its residential (urban and rural) areas," writes Carol Smyser, author of *Nature's Design*. This concept is clearly demonstrated in Santa Fe, N.M., where a distinctive architectural and landscape style reinforces a regional quality, a feel of "southwestern living."

As the Americas became populated, a "traditional" landscape style evolved, directly influenced by European gardens. Colonists favored the precise, formal "English manor" style of landscape to the wild and untamed natural vegetation. Clipped hedgerows of yews and boxwoods, expansive areas of neatly kept lawns and tidy flowerbeds provided them with a sense of the familiar.

Until recently, this type of "green" landscaping dominated over a more natural design, although the formality of American gardens has softened thru the years. As the demands placed on our natural environment became more pressing, due in part to increases in population and limited available resources, we have begun to turn to our native habitats and plants for inspiration. Across the country, people are becoming more aware of the natural landscape and learning to appreciate what each particular environment has to offer and why. We are developing what Aldo Leopold, author of *A Sand County Almanac* and considered by many to be the father of ecology, once described as a "land ethic."

Leopold said: "There is as yet no ethic dealing with man's relation to land and to the animals and plants which grow upon it. The land relation is still strictly economic, entailing privileges but not obligation. Obligations have no meaning without conscience, and the problem we face is the extension of the social conscience from people to land."

"That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics."

It seems inevitable that pressures on our natural resources will continue to increase, but so should our obligations to preserving those resources, even if it means doing so in our own backyards. As new development encroaches on and converts native habitats, we are confronted with a pressing urgency to provide other suitable habitats for the plants and animals displaced by the process. As we provide nesting sites, food and shelter for native animals and habitats for native plants, we also encourage the processes that have created the



A distinctive southwestern landscape style has aesthetic and economic benefits for commercial development.



(ABOVE) Native plants used in landscape designs help establish the unique individuality and heritage of an area.

(LEFT) Although native plants are most suitable for landscaping in the Valley, similarly adapted plants from other deserts flourish here as well.

unique qualities of that environment.

Natural landscaping does not imply merely the exact duplication of the natural environment, but is rather a compromise between the "chaos" of wildness and the rigid structure of "traditional" landscape design. It is a means of blending the intrinsic advantages of native plants with the emotional aspirations and limitations of mankind.

Native plants are best suited to the soils and climates in which they grow. They are able to exploit whatever resources are available to them in a way non-native plants cannot. In their natural environment, natives are less susceptible to disease, insects, heat, cold, drought or flooding. They have evolved over thousands of years not only to survive within the environmental parameters of a particular area, but also to thrive and successfully reproduce under these conditions. The survival of plants in habitats other than those they are adapted to requires continued alteration of that environment to meet the needs of the plant.

Traditional landscapes are relatively expensive to maintain, with lawn care making up a large portion of the costs. Lawns need regular mowing, accounting for the consumption of 200 million gallons of gasoline every year by more than 40 million lawnmowers. In addition, a well kept lawn requires fertilization. Of all commercial fertilizers produced, nearly one-sixth are used on lawns. The greening of America alone requires more fertilizer in one year than that all of India uses to produce food during the same year.

Lawns are also costly in terms of the amount of water they use, or misuse. Approximately one-half of the water consumed in the Valley is used for outdoor purposes, excluding agriculture. This is an exorbitant amount of water to squander in an environment defined by its lack of rainfall, especially when most of that water is eventually lost to the system through the casual sprinkling of our lawns.

Lawns also attract a variety of insects and diseases. Crickets, slugs, earwigs and cockroaches commonly find refuge in lawns, while the number of fungal, bacterial, and rust diseases proliferate during the hot, humid and most stressful months of the year for exotic grasses. The use of pesticides, fungicides and herbicides, which are needed to reduce competition from native grasses and herbs, have become a dependent part of lawn maintenance.

For years, people came to the southwest "for their allergies." Unfortunately, they oftentimes brought allergy-producing plants

with them. Many allergy offenders are exotic plants such as mulberry, olive and the ever-present bermuda grass. Although a few native plants produce wind blown pollen, the majority of native plants commonly used in landscape designs produce pollen that is too heavy to be carried by the wind and relies instead on insects, birds, moths or bats for pollination. These types of plants do not normally cause allergic reactions because their pollen is not found floating in the air.

For Valley landscapes, exotic or introduced plants are generally less economical to use than natives. The environmental stresses of the Sonoran Desert, such as high summer temperatures, frequent frosts during the winter and lack of available water, are often fatal to non-adapted plants, while native plants have the competitive advantage due to natural selection. Periodic but characteristic climatic extremes, such as the hard freezes experienced throughout the Valley this winter, can devastate a landscape composed of exotic plants and lead to costly replacement bills.

Although many natives may not look their

best during prolonged periods of drought or record high or low temperatures, they have a much greater rate of survival. Natives have the added advantage of being drought-tolerant, although many respond well to extra water with a lusher appearance or faster growth rate. Drip irrigation systems add greatly to the efficient use of water by soaking the root zone, rather than the whole yard. This also reduces the amount of water lost thru evaporation and helps eliminate salt buildup. Desert adapted plants do not require as much fertilization as many exotics do because they are accustomed to nutritionally poor and often saline soils.

Although native plants are most suitable for landscape designs in the Valley, many non-native plants are commonly included also. Plants that are native to other desert areas have similar adaptations, allowing them to flourish here. Plants such as Texas ranger (*Leucophyllum frutescens*), Texas ebony (*Pithecellobium flexicaule*) and feathery cassia (*Cassia artemisioides*) are examples of non-native plants that are often incorporated into landscape designs and are

TREES

Acacia constricta
White thorn acacia
Acacia pennatula
*Acacia schaffneri**
Acacia smallii
Sweet acacia
Acacia willardiana
Palo blanco
*Caesalpinia cacalaco**
Casalote
Celtis pallida
Desert hackberry
Cercidium floridum
Blue palo verde
Cercidium microphyllum
Little leaf palo verde
Cercidium praecox
Palo brea
Chilopsis linearis
Desert willow
Olneya tesota
Ironwood
Nicotiana glauca
Tree tobacco
*Pithecellobium flexicaule**
Texas ebony
Pithecellobium mexicana
Mexican ebony
*Pittosporum phylliraeoides**
Willow pittosporum
*Prosopis chilensis**
Chilean mesquite
Prosopis glandulosa
Screwbean mesquite
Prosopis juliflora
Mesquite
Prosopis velutina
Honey mesquite
*Sophora secundiflora**
Mescal bean

Tabebuia chrysantha
Trumpet tree
SHRUBS
Acacia greggii
Catclaw acacia
Ambrosia deltoidea
Bursage
Anisacanthus thurberi
Desert honeysuckle
Atriplex canescens
Four wing salt bush
Atriplex hymenelytra
Desert holly
Atriplex lentiformis
Quail bush
Baccharis sarothroides
Desert broom
Berberis haematocarpa
Red barberry
*Buddleia marrubifolia**
Butterfly bush
Caesalpinia gilliesii
Yellow bird-of-paradise
Caesalpinia mexicana
Mexican bird-of-paradise
Caesalpinia pulcherrima
Red bird-of-paradise
Caesalpinia pumila
Copper caesalpinia
Calliandra californica
Red fairy duster
Calliandra eriophylla
Fairy duster
*Cassia lindheimeriana**
Cassia
Cassia wislizeni
Cassia
Cordia boissieri
Anacahuite
Cordia parviflora
Little leaf cordia

Couania mexicana
Cliff rose
Dalea pulchra
Indigo bush
Dodonea viscosa
Hopseed bush
Encelia farinosa
Brittlebush
Haplopappus laricifolia
Turpentine bush
Ephedra trifurca
Mormon tea
Guaiacum colteri
Guaiacum
Holocantha emoryi
Crucifixion thorn
Hyptis emoryi
Desert lavender
Jaquinia pungens
Orange flower
Justicia californica
Chuparosa
Justicia sonora
Chuparosa
*Justicia spicigera**
Hummingbird bush
Krameria grayii
White ratany
Larrea tridentata
Creosote
*Leucophyllum frutescens**
Texas ranger
*Leucophyllum laevigatum**
Cenizo
Lycium spp.
Wolfberry
Lysiloma thornberi
Desert fern
Rhus trilobata
Skunk bush

Ruellia peninsularis
Ruellia
Sambucus mexicana
Desert elderberry
Simmondsia chinensis
Jojoba
*Sophora arizonica**
Mescal bean
Tecoma stans
Yellow bells
Trixis californica
Vauquelinia californica
Arizona rosewood
Ziziphus obtusifolia
Greythorn

GROUNDCOVERS AND VINES

*Acacia redolens**
Trailing acacia
Antigonon leptopus
Queen's wreath
Cissus trifoliata
Vining grape
Clematis drummondii
Virgin's bower
Dalea greggii
Trailing smoke bush
*Mascagnia lilacina**
Mascagnia macroptera
Yellow orchid vine
Melampodium leucanthum
Blackfoot daisy
Merremia aurea
Yuca
Verbena goodingii
Verbena
HERBACEOUS PERENNIALS
Artemisia ludoviciana
Wormwood

not only adapted to our type of environmental extremes but also lend themselves to the regional "feel" of the southwest. Others, such as many *Eucalyptus* spp., respond well to our climate but do not add to the regional aspect and actually detract from it.

The use of native plants in landscape designs is a logical solution to one of the obvious concerns of landscaping, namely which plants to choose. Why then does it seem that so few landscape designs incorporate native plants? Perhaps it's because people think of "natives" as something to conquer, perhaps because the desert is sometimes considered to be a "barren wasteland," consisting of nothing more than rocks and spiny cactus. Perhaps it's simply a matter of not being familiar with the possibilities.

From approximately 2,500 species of plants, the Sonoran Desert, extending as far south into Mexico as it does north into Arizona, offers a tremendous variety of native trees, shrubs, groundcovers, vines and annuals for southwestern landscapes. A list of appropriate plants and suggested uses follows this article.

DESERT GARDENING

by Mary Wilkins

For those of us who love to garden, living in this part of the Sonoran Desert presents us with a number of interesting problems. The desert can be exceeding hot, the sunlight very intense. It is, by definition, dry with rainfall scarce and sporadic. Temperatures can vary more than 30 degrees from the day's high to the nighttime low. Soils can be rock-hard and sadly lacking in organic matter.

The basis of good gardening practices is understanding the combined effects of desert climates and soils. When all these contributing factors are studied and considered, the result can be a rich and healthy harvest of home-grown vegetables. With an understanding of the constraints of the desert ecosystem comes the challenge to work within these limitations. This is the real key to successful desert gardening: don't try to change the environment drastically to suit plants which aren't meant to grow here. Keep in mind the traditional crops that sustained the people who lived here before us. Between these extremes lies a special gardening experience just waiting for those determined and patient enough to try.

If the backyard beckons with visions of lettuce, peppers, brussels sprouts and herbs but the reality is a flat expanse of stony hard ground, the first step should be to draw up a plan of action. A primary consideration must be the choice of a good location. A shady spot under the mulberry tree may be perfect for some small herb but spell certain doom for a sun-loving squash plant. Think about the needs of the plants to be grown in terms of sunshine, shade, water and nutrients and then make a plan of the entire area to be planted. Make a list of the plants, where they will be planted and how many there will be. It is a good idea to start small and be able to use what you grow.

Next, and perhaps your top priority, is preparing the garden's soil. Good soil is the foundation of good gardening. Desert soils are characteristically low in organic content and

they have high levels of soluble salts. This is often accompanied by a high pH reading. To remedy the first problem, large amounts of organic matter should be worked into the soil. This can include hay, grass clippings, leaves or other plant refuse, peat, compost and manure. Add 2 to 3 inches of this mixture and dig in prior to each planting season to improve the structure of the soil and increase its water holding ability. Compost and manure will also provide nutrients for plant growth.

Dealing with high salt levels and/or high pH reading can be a bit more complicated. Treatment depends on which salts are present and in what proportion. Agricultural professionals may refer to soil analyses for exact confirmation of soil-salt problems. Most home gardeners, however, can manage their soils by leaching with water and by adding soil sulphur. This will get rid of excessive salt build-up and re-establish the balance of dissolved salts necessary to grow healthy plants. Leaching is simply a heavy watering which dissolves excess salts in the root zone and moves them down and out of reach. This is usually done after organic matter is tilled in but before beds are prepared and planted. Soil sulphur is easy to use and can be applied at the rate of 3 lbs. per 100 sq. ft. Attention to these two tasks, although time consuming, will create a garden soil of good quality.

Shaping the soil into raised beds is a recommended practice in desert areas. This helps contain water and mulch and creates a good, flat planting area. A raised rim around the edge forms a bed that reduces water evaporation and prevents runoff. Railroad ties can be used very effectively in this manner.

Given the right conditions many vegetables and herbs will grow well in desert environments. In fact, the origins of some vegetables and many varieties of herbs can be traced to arid regions. With minor improvements, many others not native to deserts can also be grown successfully. Understanding the growing habits of native plant relatives can provide useful insights for desert gardeners. A wild

Baileya multiradiata

Desert marigold

Cassia covesii

Eriogonum fasciculatum

Buckwheat

Franseria dumosa

White bursage

Melampodium leucanthum

Blackfoot daisy

Muhlenbergia spp.

Muhly grass

Oenothera berlandieri

Mexican evening primrose

Penstemon spp.

Beardtongue

*Salvia chamaedryoides**

Blue sage

*Salvia farinacea**

Mealy-cup sage

*Salvia greggii**

Texas sage

Salvia munzii

Baja sage

Sphaeralcea ambigua

Globe mallow

Verbena goodingii

Verbena

Zauschneria californica

Hummingbird bush

Carnegiea gigantea

Saguaro

Dasyliirion wheeleri

Desert spoon

Echinocereus engelmannii

Hedgehog cactus

Ferocactus spp.

Barrel cactus

Fouquieria splendens

Ocotillo

*Hesperaloe parviflora**

Red yucca

Lophocereus schottii fa.

monstrosus

Totem pole cactus

Mammillaria spp.

Pincushion cactus

Nolina bigelovii

Bear grass

Opuntia spp.

Prickly pear, cholla

Stenocereus thurberi

Organ pipe cactus

Yucca baccata

Banana yucca

Yucca brevifolia

Joshua tree

Yucca elata

Soap tree yucca

* Not native to the Sonoran Desert; includes part of Arizona and the Mexican states of Sonora, Baja California Norte, Baja California Sur.

CACTI AND SUCCULENTS

Agave spp.

Century plant

Aloe spp.

Aloe

Asclepias subulata

Desert milkweed

*Beaucarnea recurvata**

Ponytail palm



Using railroad ties to build a raised bed helps contain water and mulch and creates a good, flat planting area.

lettuce relative grows vigorously during our desert winter while the native gourds, cousins of squash and cucumber, relish the hot summer months. Translated into gardening terms, lettuce would be a cool season crop and squash a warm season one. Vegetables are generally divided into these two categories.

The cool season group includes plants which grow and produce well only in cool weather. They can even withstand slightly freezing temperatures. For the most part, cool season vegetables are the leafy and root types, including the entire cabbage family. Beets, brussels sprouts, cabbage, chard, leeks, carrots, lettuce, peas, radishes, spinach and turnips belong to the cool season category. Planting these crops must be carefully timed so they mature before the hot weather arrives or they simply won't produce.

Warm season vegetables include the fruiting types like beans, corn, cucumbers, eggplant, melons, okra, peppers, pumpkins, squash, and tomatoes. These will not tolerate frost and need warm temperatures to grow and set fruit. Extremely high temperatures,

however, can cause sunburn and poor quality of fruit. Some provision for shading can help during the hottest months.

The following planting chart is meant to give some very general guidelines for the two main planting periods in the Phoenix area. It is by no means all-inclusive and will vary slightly from year to year depending on weather trends. Cool season crops are planted in late summer through winter. Early spring is generally the period for planting warm season vegetables. Watch the weather, though. There is always that 10% probability of frost until the tenth of March. A second planting of warm season crops is sometimes successful later in the summer.

Vegetables generally grown from seed are beans, beets, carrots, corn, cucumber, lettuce, cantaloupe, peas, pumpkin, radish, spinach, squash and watermelon. It can speed the germination time of some seeds if they are allowed to soak in water several hours before sowing. When planting seed, prepare a trench twice as deep as the recommended depth and sprinkle seeds carefully to avoid crowding.

Then cover with loose, well-sifted compost, potting soil or garden soil to just half the original depth of the trench. Pack lightly and mist or spray thoroughly. Keep the soil moist until the seeds sprout as they will die if allowed to dry out. As seedlings grow, thinning may be necessary and deep watering should take the place of misting or spraying.

Transplants are seedlings which have been started in containers. This method gives the gardener a head-start over direct seeding and eliminates the problem of difficult-to-germinate varieties. Some plants, though, do not take kindly to transplanting and are best started from seed. This is true of members of the squash family. Vegetables which are usually amenable to transplanting include broccoli, cabbage, cauliflower, eggplant, peppers and tomatoes. Before setting transplants out into the garden allow them to "harden off" for 3 or 4 days by moving them into a sunny location for several hours each day. Choose a cloudy day if possible or plan to transplant in the evening so as to lessen the immediate effect of transplant shock. Water

thoroughly before gently removing plants from their containers. Keep as much of the original soil as possible around the roots because young root hairs are easily damaged. Set the plants in the prepared bed and pack the soil gently around them. A layer of mulch at this time can help alleviate shock, and cardboard boxes can provide protection from excess heat, cold or wind in the first few days.

COOL-SEASON VEGETABLES	PLANTING DATE
Beets	Sept. 1-March 15
Broccoli (plants)	Sept 1-Dec. 1
Brussels sprouts (plants)	Sept. 1-Dec. 1
Cabbage (plants)	Sept. 15-Jan. 1
Carrots	Sept. 1-March 1
Cauliflower	Sept. 15-Jan. 1
Chard	Sept. 1-March 1
Leeks	Sept. 1-Jan. 1
Lettuce	Sept. 1-March 1
Peas	Aug. 15-Dec. 1
Radish	Sept. 1-April 1
Spinach	Sept. 1-Feb. 1
Turnip	Sept. 1-Feb. 1

WARM-SEASON VEGETABLES	PLANTING DATE
Beans bush type (2 dates)	Feb. 15-Mar. 15 July 25-Aug. 15
Cantaloupe	March 15-May 1
Corn (2 dates)	Feb. 15-Mar. 15 July 20-Aug. 20
Cucumber	March 1-April 1
Eggplant (plants)	Feb 15.-April 15
Okra	March 15-June 1
Peppers (plants)	March 1-April 15
Pumpkins	April 1-June 1
Squash, summer (2 dates)	Feb. 15-May 1 July 1-Aug. 1
Squash, winter	March 1-Aug. 1
Tomatoes (plants) (2 dates)	Feb. 15-Mar. 15 July 15-Sept. 1
Watermelon	Feb. 15-May 31

**TIPS TOWARD
GOOD GARDENING**

1. **SELECT A GOOD LOCATION.** Consider the sunlight and shade requirements of the plants you want to grow.
2. **PLAN THE LAYOUT OF GARDEN.** Make a rough sketch of the planting beds and which plants will go where. Keep it small to start.
3. **PREPARE THE SOIL AND THE BEDS.** Add organic matter and soil amendments and shape the beds according to your plan.

4. **CHOOSE RECOMMENDED PLANT VARIETIES.** Plant those varieties which are known to do well in the desert.
5. **TIME PLANTING WITH SEASONS.** Learn which are cool and warm season vegetables and plant accordingly.
6. **IRRIGATE BY DEEP WATERING.** Use hose and bubbler and water slowly for 5 minutes or longer, or consider drip system.
7. **MULCH.** In hot weather layer mulch on soil to reduce soil temperatures and water evaporation.
8. **CONTROL PESTS AND WEEDS.** Be on the lookout early to deal with these problems before they get out of hand.
9. **HARVEST AND ENJOY.**

HERBS

Herbs occupy a special place in the plant world. They are widely regarded as the most mysterious and marvelous of its members. Growing herbs binds us to that age in history when herbal potions and remedies were thought to cure most any ailment. Many familiar herbs are native to the Mediterranean region; others have their origins closer to home, in North and South America. Whatever their origins, herbs have little in common (from a botanical standpoint) other than the all-inclusive term, herbs. They can be annuals, biennials or perennials; non-woody plants, shrubs or trees. What unifies them as a group and makes them unique is that their flowers, seeds, leaves, roots or bark are used for flavor, fragrance, medicinal and cosmetic purposes; and as teas and balms to soothe the senses.

Among the herbs best suited to our desert growing conditions are basil, chives, cilantro (coriander), dill, garlic, margoram, the mints, oregano, parsley, rosemary, sage, savory (the winter type), thyme (English, French and lemon varieties). With a little extra care, many others will also thrive. Herbs are relatively easy to propagate from seeds and cuttings. Planting times vary according to each herb's longevity. Perennials such as mints, sage and rosemary do better if set out from late October thru December.

This gives them time to establish a deep root system before the hot summer weather sets in. Annuals such as basil and dill, should be planted in late February or early March, after frost danger is past.

Once planted, herbs must not be completely neglected for although they are undemanding in some climates, they must be given sufficient water and protection from afternoon sun during our desert summers. Hot winds can be very destructive, so a good layer of mulch will

help protect them from dessication. Soils which are slightly alkaline do not present a problem and in fact are preferred by many herbs, but hard, compacted soils should be amended with compost and sand for good drainage. Fertilizing can be done sparingly but many herb growers report little need for it if soils have previously been used for gardening. What is agreed upon, however, is the need to provide afternoon shade. Some herbs can take full sun for a six-hour period or more, but they will do best if they get sun in the morning and they are in shade by 3 p.m.

For an indoor herb garden plants can be started any time during the year in a sunny south or east window or under a skylight. Use rich potting soil with good drainage and give indoor plants a little fertilizer once a month.

Herbs may also be grown in containers for patio use, or in hanging baskets. This calls for more frequent watering since pots and baskets tend to dry out quickly in summer heat. Plastic pots conserve moisture better than clay, but for decorative purposes clay might be used as an outer container with plastic pots placed inside.

HERBS SUITABLE FOR DESERT GARDENING A = Annual
P = Perennial

Basil, Sweet (A)	Lemon Balm (P)
Basil, Dark Opal (A)	Marjoram, Sweet (A)
Borage (A)	Mint (P)
Catnip (P)	Oregano (P)
Chamomile (A)	Parsley (B)
Chervil, Curved (A)	(grow as annual)
Chives (P)	Rosemary (P)
Coriander (A)	Sage (P)
Dill (A)	Summer Savory (A)
Horehound (P)	Tarragon (P)
Lavender (P)	Thyme (P)

Vegetable Gardening References

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- Ten Steps to a Successful Vegetable Garden.* Univ. of Arizona Cooperative Extension Service. Tucson
- Desert Gardening.* Sunset Book

Herb References

- Boyce-Thompson SW Arboretum
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- Herb Gardening in Texas* Sol Metzger. Lone Star Books

PLANTING TIPS FOR DESERT GARDENERS

by Judy L. Mielke

Planting procedures are much the same, no matter where you live, whether in the desert, near the ocean, or on a mountain. There is, however, one big difference about planting in the desert — the soil.

Our native soils are often compacted and rocky, and may be underlain by caliche (solidified calcium carbonate). This hard, light-colored rock can vary in depth from a few inches to several feet, and since neither roots nor water can penetrate caliche, it must be broken up and preferably removed. An ordinary shovel barely makes a dent in caliche; the most effective tools for breaking through it are picks and iron digging bars.

The planting hole should be generous-sized. The bigger the better, but at least twice the size of the container.

After digging, if you want to take a rest, you can use this time to fill the hole with water. This procedure does two things: it provides a moist environment for the new plant and indicates any problems with drainage. If the water hasn't soaked in after an hour or so, bail out the puddle and dig deeper to check for caliche.

Most container plants are grown in a rich, organic soil, while native desert soils are usually severely lacking in organic matter. You can provide a transition between the potting soil and the "real world" by mixing some organic matter such as forest mulch or peat moss about half and half with the soil you removed from the hole.

Fertilizer isn't essential when planting desert plants, as they have adapted to growing in nutrient poor soil, however at the Desert Botanical Garden we use a slow-release fertilizer to give the plants a boost.

After you have thoroughly mixed the soil amendments with the native soil, put some of this fill back into the hole.

Next, unpot the plant and have a look at the rootball. If the roots have grown together into a tight mass, loosen them with your fingers. Also check for any damaged or broken roots, and trim these off.

The new plant should be positioned in the hole so that the top of the rootball is level with the existing soil grade. Replace the fill soil, pressing it firmly around the rootball.

It is critical to give the new plant a thorough watering immediately after planting. You can build a basin of soil around the plant and fill it with water, or put a hose turned to low volume by the plant's base and let it run for several hours.

Some horticulturists recommend pruning part of the new transplant's foliage to compensate for root damage suffered during the planting process, but unless severe wilting occurs, pruning shouldn't be necessary. In fact, recent studies have shown that compensatory pruning can actually slow the plant's recovery. Auxins (plant hormones that, among other things, stimulate root development) are abundant in new growth, so by pruning, you're reducing the plant's natural ability to stimulate root regeneration.

Young, tender plant growth is especially tasty to rabbits and squirrels. If you have this sort of wildlife in your area, you should protect the new plant. A three-foot-high piece of poultry fencing encircling the plant will deter rabbits, but a finer mesh screen with a top is necessary to prevent squirrels from nibbling.

One of the most common questions asked by gardeners new to the desert is: "When is the best time to plant?" The answer to that depends on what type of plant you have in mind. Frost-tender plants such as desert fern (*Lysiloma thornberi*) and brittlebush (*Encelia farinosa*) should be planted in late winter after all danger of frost is past (usually

by March 10). Most other plants can be planted throughout the year, but the best time is fall. The cooler temperatures during fall, winter and spring promote good root growth and allow the plant to become fairly well established before the stress of summer's heat.

Cloudy days aren't abundant in the desert, but if you can manage to plant during one, the new transplant will have an easier start on life.

Another oft-repeated question concerns watering: "How much and how often?" That's a tough one to answer, since there are so many factors to consider, including soil type, kind and size of plant, and time of year.

Generally, a thorough soaking at regular intervals is best. The plant responds to this by sending out roots deep and wide. A well-developed root system anchors the plant firmly and, in times of drought, allows it to tap into reserves of moisture deeper in the soil. A plant whose roots have been encouraged by shallow waterings to remain near the surface will suffer during prolonged drought.

Summer's high temperatures and intense sunlight cause rapid evaporation of moisture from the soil and increased transpiration from the foliage, so you'll need to water more often than in cooler weather. Young plants may require watering twice a week, while older, established plants should be able to get by on less frequent irrigations.

In winter, the number of waterings can be reduced to one-half or even one-third of the summer schedule.

Drip irrigation can take much of the work out of watering. This method, which uses slender black plastic tubing and emitters to deliver water directly to the plant roots also saves water and therefore money.

A drip system is easy to set up. You can attach it to any existing water faucet, incorporating a filter, antisiphon (if there isn't one already on the faucet) and pressure regulator. The main line, or half-inch polyethylene tubing runs among the plants, with quarter-inch "spaghetti" tubing extending from the main line to each individual plant. Emitters placed at the ends of the spaghetti tubing regulate the water flow. They are available in different sizes, ranked according to how many gallons per hour they emit. Quarter-inch soaker tubing, which has tiny holes spaced along the length of it, is useful for dense plantings or vegetable gardens.

The black plastic tubing is usually buried several inches deep for aesthetic reasons, and being protected from the sunlight prolongs its life.

Two research projects are currently in progress at the Desert Botanical Garden that will provide specific data to support a position on the subject of a particular plant's drought tolerance. Most existing information about watering needs of "drought tolerant" plants comes from empirical observation and the place of origin of individual species.

The first project was begun in July 1986 and is funded by a 3-year grant from the City of Scottsdale. The objective of this project is to determine the minimum water requirements of landscape plants that are widely used in the metropolitan area. Fifteen species of native and introduced plants will be grown in each of these irrigation treatments. The irrigation schedule will be determined during the course of the study and will be based on the physiological parameters such as evaporative demand and a plant's ability to extract water from the soil. The plants will be watered with a drip irrigation system at the rate of one gallon per hour. The three irrigation schedules will be low, medium (twice as much as the low) and high (three times as much as the low treatment).

Plants produce their food through photosynthesis, a chemical process involving light. This process is not 100% efficient in terms of its use of light. The light that is not used is emitted, or given off, as fluorescence, much the same as a fluorescent light bulb. This quantity of light is measurable using a state-of-the-art instrument called a plant productivity fluorometer. (It is important to note that when a plant is stressed, either by water stress or temperature stress, the percentage of fluorescence increases.)

Using the fluorometer on the plants in three different watering regimes we will begin to collect the data we need to recommend irrigation schedules, i.e., quantities of water per application per plant species.

Because drought is a combination of factors, we will also study how these plants tolerate temperature extremes (thermo-tolerance), particularly with respect to high heat. This part of the project will begin in May 1987 and will be funded by the Arizona Municipal Water Users Association. The instrumentation will be used on both projects.

The plant pigment used in photosynthesis is called chlorophyll, which also happens to be the pigment that gives plants their green color. When fluorescence occurs, it is because chlorophyll is not using light efficiently. Chlorophyll fluorescence is temperature de-

pendent and species specific. This means that for a particular species, regardless of the individual plant of that species, a temperature threshold exists. This threshold can be for cold or heat extremes. In this experiment, leaves of each of the species will be slowly heated and continuously measured with the fluorometer. As heat increases, the amount (or percentage) of fluorescence increases until that particular species reaches its threshold. When this happens, the leaf ceases to function normally. Photosynthesis stops and the leaf, if continuously subjected to this treatment, will die.

This second project requires less time than the first one and can determine *relative* drought tolerance. However, in order to save water the minimum water use requirements must be determined. This will allow us to recommend the proper quantity of water to apply without wasting it through evaporation.

Supervising the two research projects are Steve Priebe, chief horticulturist, Desert Botanical Garden; Dr. Robert A. Bell, research botanist, Desert Botanical Garden; and Dr. Stan R. Szarek, associate professor, Arizona State University. Plant materials were donated by the Arizona Nursery Association and irrigation supplies by Artesco.

DROUGHT TOLERANT PLANTS: **HOW MUCH WATER** **IS ENOUGH?** *by Steve Priebe*



POOLSCAPING

by Judy L. Mielke

Lush, tropical foliage seems to go along with the refreshing sound of splashing water. Hibiscus, palms and passion vine are the sort of plants that usually surround swimming pools in the desert southwest.

But . . . what if you're a pool owner who has a passion for desert landscaping? Do swimming pools and water-thrifty plants mix?

Yes! Attractive, colorful, even lush pool plantings can be created from the broad palette of desert plants used in landscaping. The colorful flowers of plants such as brittlebush and Mexican bird of paradise sparkle along with the water, while deep green foliage belonging to Texas ebony, hop bush and Arizona yellow bells helps create an oasis feeling.

Beauty, however, isn't the only consideration in designing a poolscape. The plants should be relatively free of litter (fallen leaves, flowers, seeds and bark). No plant is completely litter-free, but there are some messy types to steer clear of. Bougainvillea, as beautiful as it is, can be a real nuisance when the flower bracts dry up and blow around. Mesquite is a wonderful desert shade tree, but it has also acquired the reputation of being "messy," so many people don't plant it near their pools. If a moderate amount of litter can be tolerated (this means more raking, sweeping and pool skimming), the choice of plants becomes much greater.

Plants used near the swimming pool shouldn't have thorns or spines that might cause injury. This is particularly important with shrubs and other low plants. A few of the trees recommended later on in this article have small thorns, but since the foliage is overhead, it's not as much of a concern. Judicious pruning can help insure that thorny branches are kept up, out of harm's way.

The profuse flowering of some desert plants can be a mixed blessing. While the flowers provide color, they may also attract bees. Rosemary and palo verde are two plants in particular that should be used with caution in the pool area, especially if anyone in the family is allergic to bee stings.

Some plants such as Texas red sage and desert marigold are sensitive to overwatering and are better off not planted near the pool's edge where they might be subjected to splashing. Desert plants in general don't seem to be adversely affected by some exposure to chlorinated water.

Another attribute of desert plants in regard to use near a swimming pool is their well-behaved roots. One exception is trailing acacia, which can be invasive. Oleander, while not a desert native but still water-thrifty, is notorious for having invasive roots.

In some situations, having potted plants around the pool may be a good alternative to planting directly in the ground. Or, the pots can be used in addition to regular plantings — for seasonal color from annuals, or to highlight an exceptional specimen such as a ponytail palm or totem pole cactus.

All pools require periodic backflushing to clean the filter. The chlorinated water that is pumped out of the pool during backflushing needs to be disposed of somewhere in the yard. One solution is to have an area covered just with river rock or crushed granite (no plants), where the backflush water can seep into the ground. Expanding clay, which is common in desert soil, swells when it gets wet, causing pressure on the pool sides and possibly cracking. To lessen this danger, Ed Drew of Shasta Pools cautions that the area for backflush should be at least 5 to 10 feet from the pool. Even further away would be better.

All cities in the Phoenix metropolitan area require back yards with a swimming pool to be surrounded by a fence at least 5 feet high, with self-closing gates. As a further safety measure, a pool cover can be stretched over the swimming pool when it isn't being used. A cover will also reduce the amount of debris that falls into the pool.

The desert plants listed have been selected because they possess one or several of the following characteristics: pleasing form; attractive, harmless foliage; showy flowers; low litter; non-invasive roots; not attractive to bees.



TREES

- Acacia pennatula*
- Acacia salicina*
willow wattle
- Acacia smallii*
sweet acacia
- Acacia stenophylla*
shoestring acacia
- Acacia willardiana*
palo blanco
- Geijera parviflora*
Australian willow
- Pithecellobium flexicaule*
Texas ebony
- Pittosporum phillyraeoides*
willow pittosporum
- Sophora secundiflora*
Texas mountain laurel
- Tecoma stans*
Arizona yellow bells

SHRUBS

- Baccharis sarothroides* (male)
desert broom
- Caesalpinia Gilliesii*
Mexican bird of paradise
- Caesalpinia pulcherrima*
red bird of paradise
- Calliandra californica*
Baja fairy duster
- Dodonaea viscosa*
hop bush



Red bird of paradise and deep green foliage set off a sparkling swimming pool.

Encelia farinosa
brittlebush
Hyptis emoryi
desert-lavender
Justicia spicigera
orange hummingbird plant
Leucophyllum frutescens
Texas ranger
Leucophyllum laevigatum
cenizo
Lysiloma thornberi
desert fern
Ruellia californica
Salvia greggii
Texas red sage
Simmondsia chinensis
jojoba
Tagetes lemmoni
Mt. Lemmon marigold
Vauquelinia californica
Arizona rosewood

GROUNDCOVERS

Acacia redolens
trailing acacia
Asparagus densiflorus "Sprengeri"
asparagus fern
Dalea greggii
trailing smoke bush
Gazania rigens
Lantana monteridensis
trailing lantana
Myoporum parvifolium

VINES

Cissus trifoliata
possum-grape
Macfadyena unguis-cati
cat's claw vine
Mascagnia macroptera
yellow orchid vine
Meremia aurea
yuca

PERENNIALS

Baileya multiradiata
desert marigold
Melampodium leucanthum
blackfoot daisy
Nierembergia hippomanica v. *violacea*
purple cup flower
Penstemon parryi
beardtongue
Salvia farinacea
mealy-cup sage
Sphaeralcea ambigua
globe mallow
Verbena gooddingii
Verbena pulchella

ANNUALS

Catharanthus roseus
Madagascar periwinkle
Celosia cristata
cockscomb

Celosia plumosa
Cosmos sulphureus
Dimorphotheca sinuata
African daisy
Dyssodia tenuiloba
golden fleece
Eschscholtzia californica
California poppy
Papaver rhoeas
Shirley poppy
Portulaca grandiflora
moss rose
Tagetes spp.
marigold

SUCCULENTS & SEMI-SUCCULENTS

Agave vilmoriniana
octopus agave
Agave weberi
smooth-edged agave
Aloe spp.
Beaucarnea recurvata
ponytail palm
Hesperaloe parviflora
red yucca
Lophocereus schottii fa. *monstrosus*
totem pole cactus
Portulacaria afra
elephant's food
Yucca elata
soaptree yucca
Yucca recurvifolia
curveleaf yucca



*by Kent C. Newland
Water Resources Specialist
City of Phoenix*

Phoenicians today live in a desert region as complex as a maze with moving walls. There are rewards of a rich native flora and a mild climate and there are also challenges of a limited water supply with an expanding population.

Planning trends for the City of Phoenix predict a population of 1.4 million people by the year 2000. This once agricultural Valley has given way to urban explosion. The water demands are no longer for sprawling cotton fields. In fact, Phoenix delivers no water to agricultural enterprises. Instead, 70% of the water in the year 2000 will be delivered to single family homes, while industrial and commercial complexes will demand 25% of the water.

Presently, a typical Phoenix residence uses 50% of its water in landscape irrigation. An average home in Phoenix has 63% of the landscapable area in grass and 37% in some type of desert landscaping. Overreacting, some homeowners have reduced their water consumption by conversion to vast areas of gravel and cacti. While this landscaping may save water and be low maintenance, it has led to negative feelings about low water use landscaping.

The City of Phoenix joins other leading Southwest-Sunbelt cities who believe there are positive alternatives to gravel moonscapes and water intensive yards. Xeriscape is rapidly becoming a creative, as well as practical choice of landscape professionals, conservationists and city planners.

Xeriscape is defined as the conservation of water through creative landscaping. Xeri is derived from the Greek xeros, meaning dry. Xeriscape produces creative landscaping and efficient water use by using low water use plant material, efficient irrigation systems and appropriate maintenance practices for a semi-arid region.

XERISCAPE:

There are seven basic principles to Xeriscape:

- Planning & Design
- Use of Low Water Use Plants
- Reduced Turf Areas
- Efficient Irrigation
- Soil Improvement
- Use of Mulches
- Appropriate Maintenance

The key component in a successful residential Xeriscape is planning and design. A Xeriscape design starts with a site plan drawn to scale. The plan should show all existing structures, hard surfaces, plants and views to be enhanced. The homeowner's lifestyle is of primary importance in the design. How much space is necessary for outdoor recreation, children, pets and gardening? With study and observation a homeowner can readily implement simple design concepts which can result in a beautiful customized Xeriscape.

A typical Phoenix Xeriscape could have, as functional design concepts, low water use trees in the front and back yards to shade the house, with low water use shrubs and accent plants for seasonal color in both yards. Low water use groundcovers are a perfect replacement for front yard grass, while deciduous vines provide shade from the summer sun on exterior walls. For recreation a small backyard mini-oasis, with grass, meets the active family's needs.

Xeriscape clearly has unlimited potential to reduce residential water consumption, allow Phoenixians more recreational time while increasing the aesthetic values of the environment.

A vast spectrum of colorful low water use plants for Xeriscape designs have been cultivated and are continually being introduced from the arid and semi-arid regions of North America, South America, Australia, Africa and Asia. Regional botanical gardens are wonderful sources of new low water use

plant introductions. Xeriscape gardeners should visit the demonstration gardens and shop regularly at the plant sales.

Most nurseries in the Phoenix metro area feature a low water use plant section for residential use. Landscape professionals are becoming increasingly aware of how low water use trees, shrubs, groundcovers, vines and accent plants can be blended for a harmonious residential Xeriscape.

Xeriscape does not ban grass. However, substantial residential water savings can be achieved with a major reduction in grass. The use of grass in a residential Xeriscape should be directly related to the lifestyle of the resident. Most people use secluded backyards as opposed to an open front yard. In a Xeriscape design, front yard turf will ideally be substituted with rapid growing groundcovers. The backyard will have sufficient grass for play or a mini-oasis around the patio with favorite small trees, shrubs and accent plants. Usually 600 sq. ft. (20 x 30 ft.) is considered substantial turf for active recreation. The City of Phoenix Water Conservation Office encourages pool owners to avoid grass and consider it a trade-off for water used in the pool.

An efficient irrigation system in a Xeriscape is vital to realize water savings. The irrigation system should always be planned in conjunction with the Xeriscape and many irrigation supply stores are happy to assist the home gardener in irrigation system planning.

When developing the irrigation system remember:

Establish a scheduled time to water and how much water to apply. This can be made more convenient by installing an irrigation controller and remember to water in the early morning to avoid evaporation loss.

Sprinklers are best designed for the small mini-oasis of grass. While low water use trees, shrubs, groundcovers, vines and accent plants can be watered more efficiently with low volume drip

or bubbler emitters.

Money will be saved by establishing a regular irrigation maintenance program, this includes replacing broken spray heads with the same appropriate head-style and periodic adjustments of the controller to match seasonal or temperature variances.

It may seem to be time-consuming, but by establishing a record-keeping system, noting monthly water consumption and seasonal water use, an annual water budget can be developed.

Xeriscape design, well-chosen plant material and irrigation systems will only succeed if the right groundwork has been done. The soil must be improved to allow for absorption of nutrients and to increase the water holding capacity of the soil. Soil testing, provided by the Cooperative Extension Service, will tell the gardener what nutrients should be added and the drainage characteristics, as drainage is critical for many low water use plants. Investigate using hydrophilic (water loving) soil polymers which show promise of decreasing landscape water use.

Regular maintenance of a Xeriscape preserves the special look it was designed to have, as well as, again, saving water. Pruning, weeding, proper fertilization, pest control and irrigation system adjustment add up to tremendous water savings. Water savings in a Xeriscape residence will be substantial — as much as 50%.

With the thousands of single family homes in the Phoenix metro-area and new housing developments starting up regularly, the impact of Xeriscape can substantially help prepare Phoenix to meet the limited water supply challenge.

Living in a desert requires Phoenixians make responsible decisions about water use and the quality of life. With Xeriscape planning today, we can design an urban landscape that will be extremely water efficient and aesthetic without compromising our lifestyle.

Creative Residential Landscapes in a Desert City



DESERT BOTANICAL GARDEN

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A view of Archer House Patio and the Demonstration Garden at the Desert Botanical Garden. Visitors to the Garden can see mature specimens of desert plants in a natural setting. Throughout the year the Garden offers workshops and classes on landscaping with drought tolerant plants. A quarterly Calendar of Events is available upon request.

